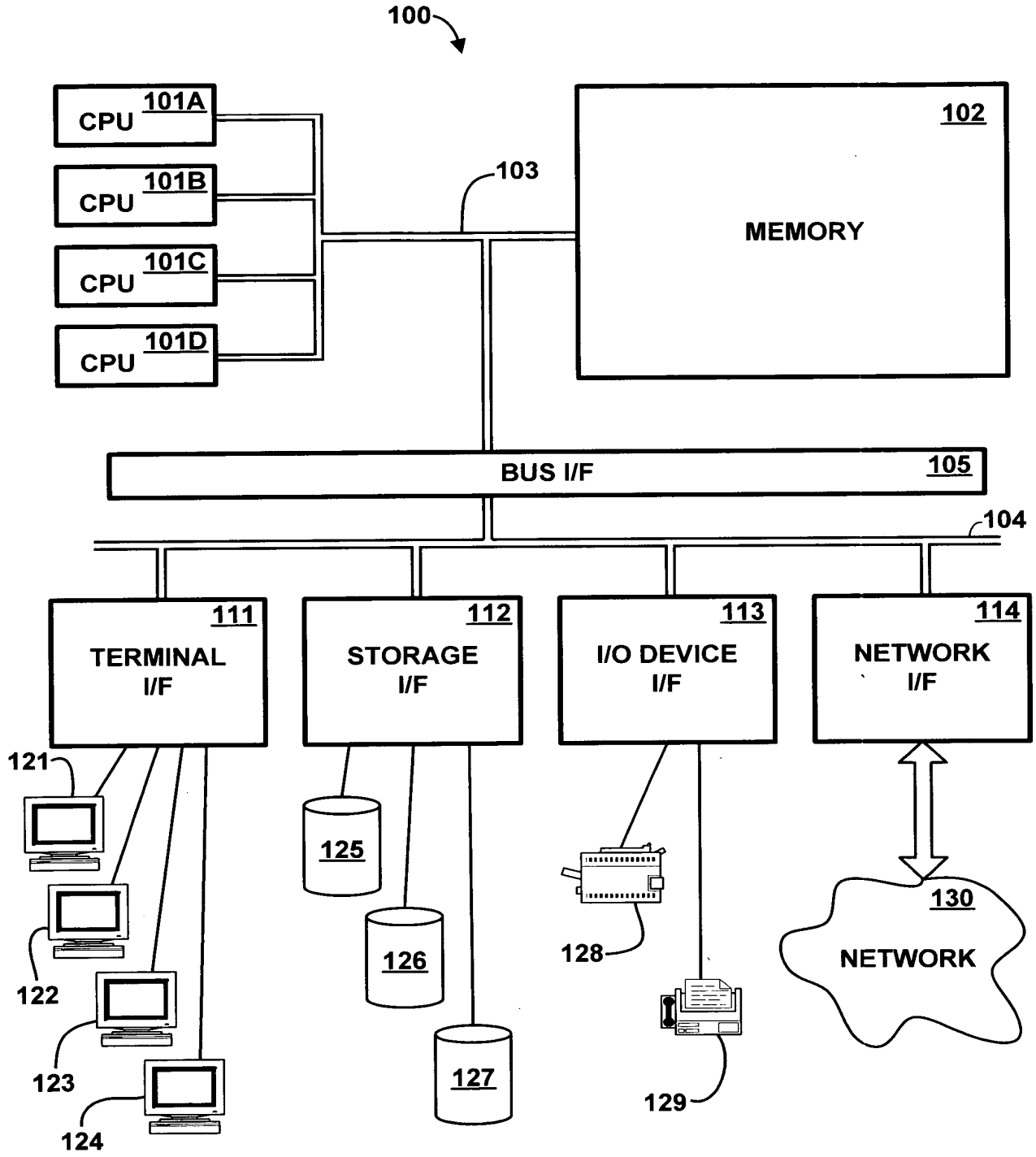

100
CPU 101A
CPU 101B
CPU 101C
CPU 101D
103
102
MEMORY
BUS I/F 105
104
111
TERMINAL I/F
112
STORAGE I/F
113
I/O DEVICE I/F
114
NETWORK I/F
121
122
123
124
125
126
127
128
129
130
NETWORK

FIG.1

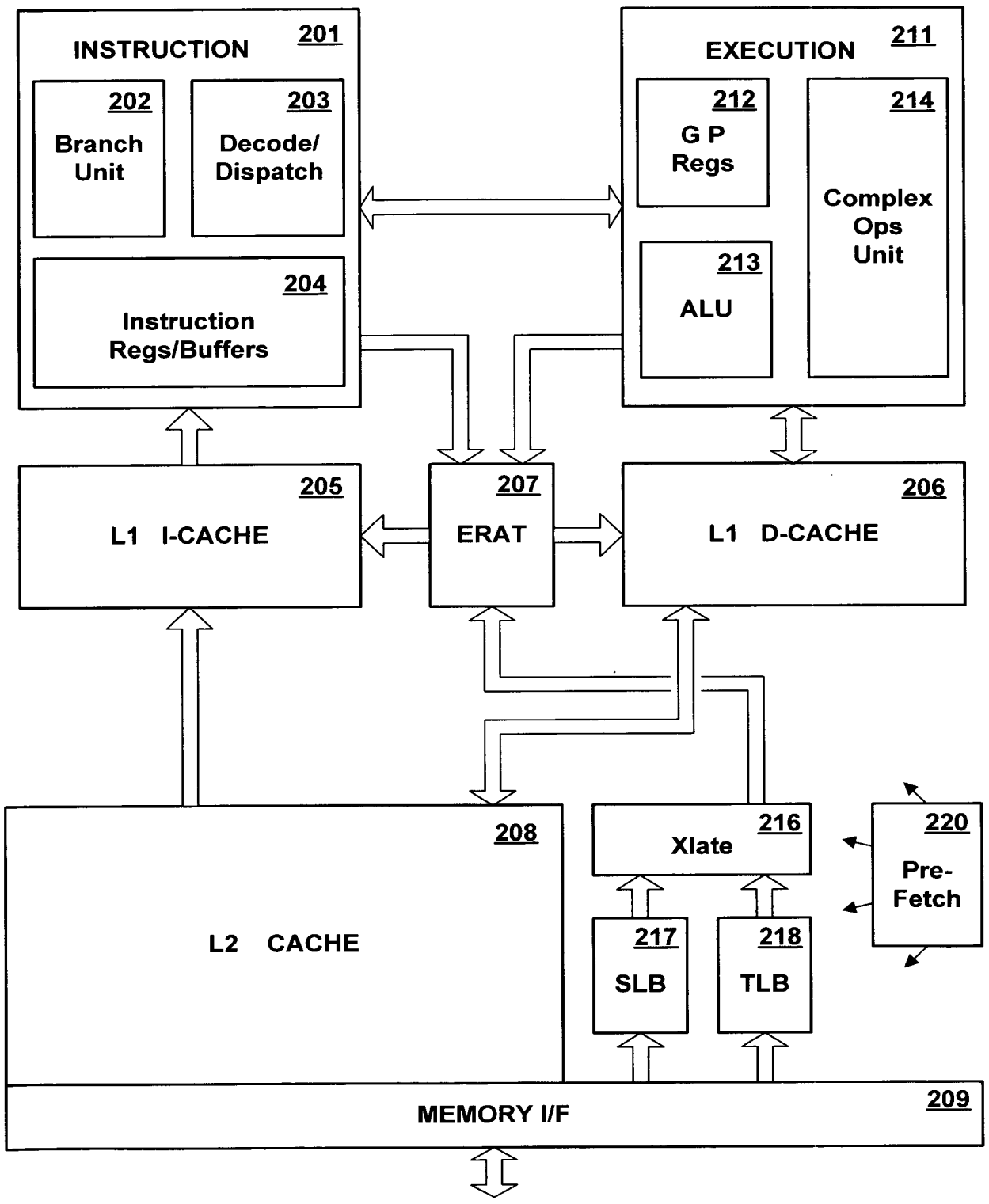

101
INSTRUCTION
201
202
Branch Unit
203
Decode/ Dispatch
204
Instruction Regs/Buffers
EXECUTION
211
212
G P Regs
214
Complex Ops Unit
213
ALU
205
L1 I-CACHE
207
ERAT
206
L1 D-CACHE
208
L2 CACHE
216
Xlate
220
Pre-Fetch
217
SLB
218
TLB
209
MEMORY I/F

FIG. 2

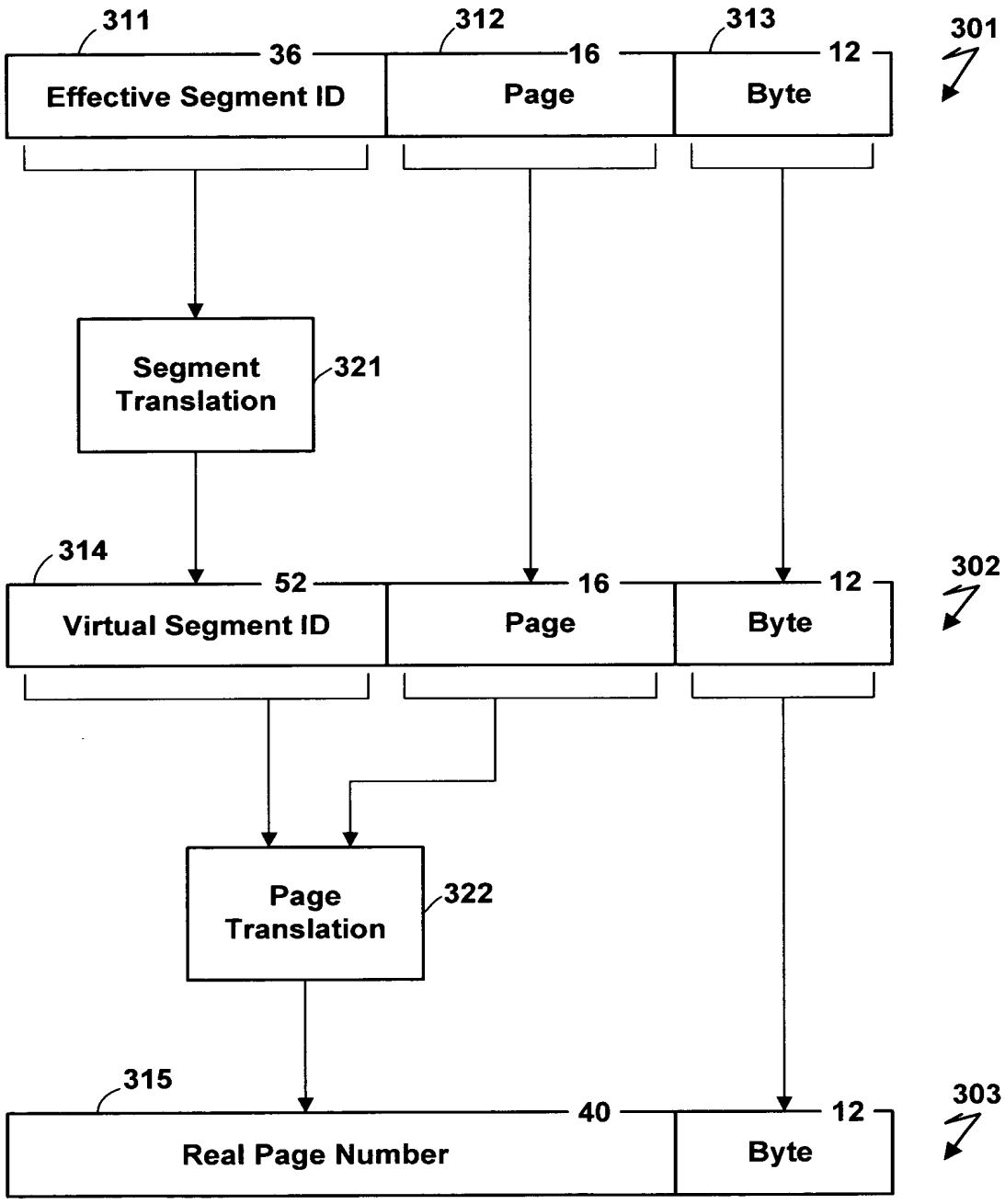

311
312
313
301
36
16
12
Effective Segment ID
Page
Byte
Segment Translation
321
314
52
16
12
302
Virtual Segment ID
Page
Byte
Page Translation
322
315
40
12
303
Real Page Number
Byte

FIG.3

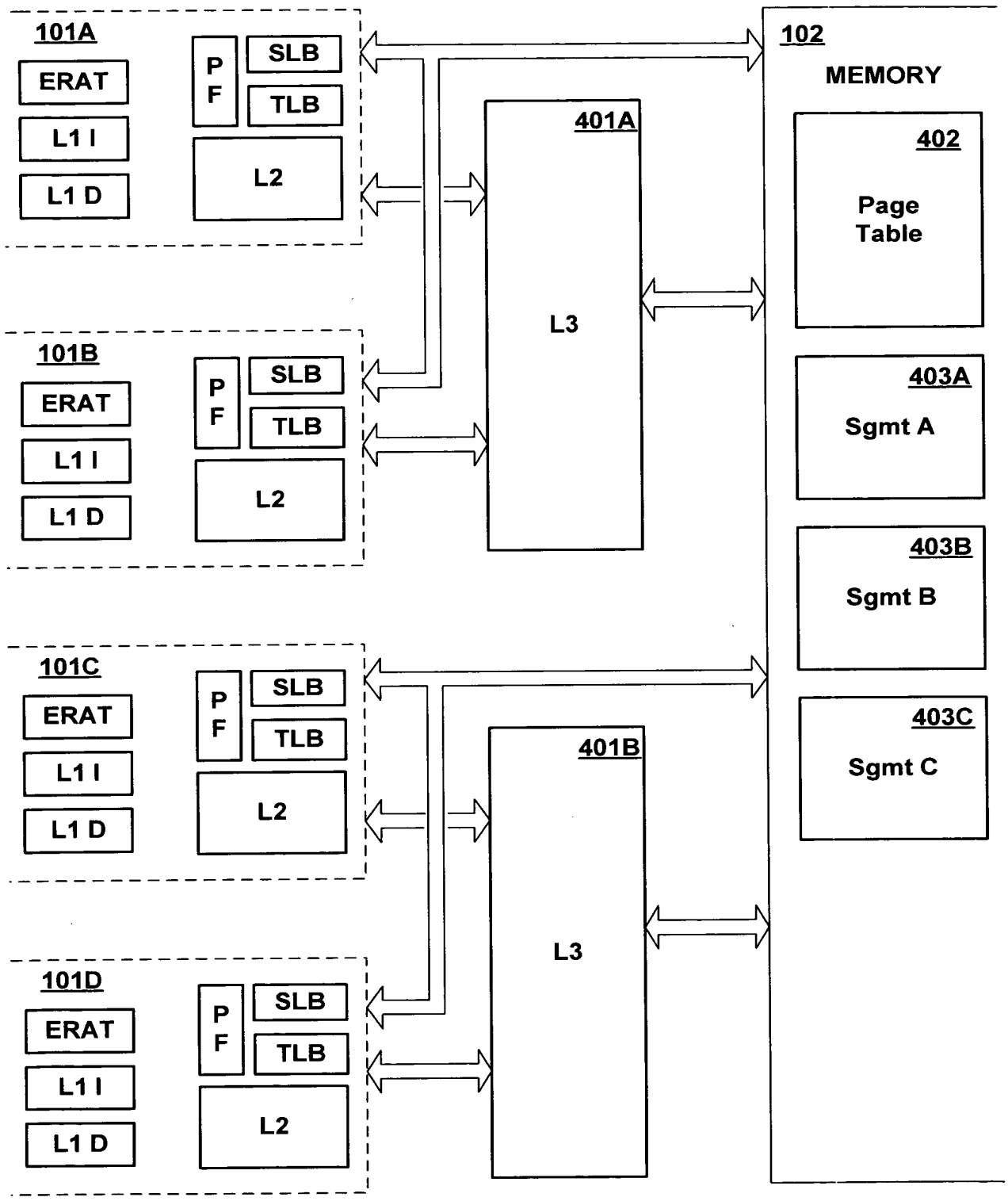

101A
ERAT
L1 I
L1 D
P F
SLB
TLB
L2
101B
ERAT
L1 I
L1 D
P F
SLB
TLB
L2
101C
ERAT
L1 I
L1 D
P F
SLB
TLB
L2
101D
ERAT
L1 I
L1 D
P F
SLB
TLB
L2
401A
L3
401B
L3
102
MEMORY
402
Page Table
403A
Sgmt A
403B
Sgmt B
403C
Sgmt C

FIG. 4

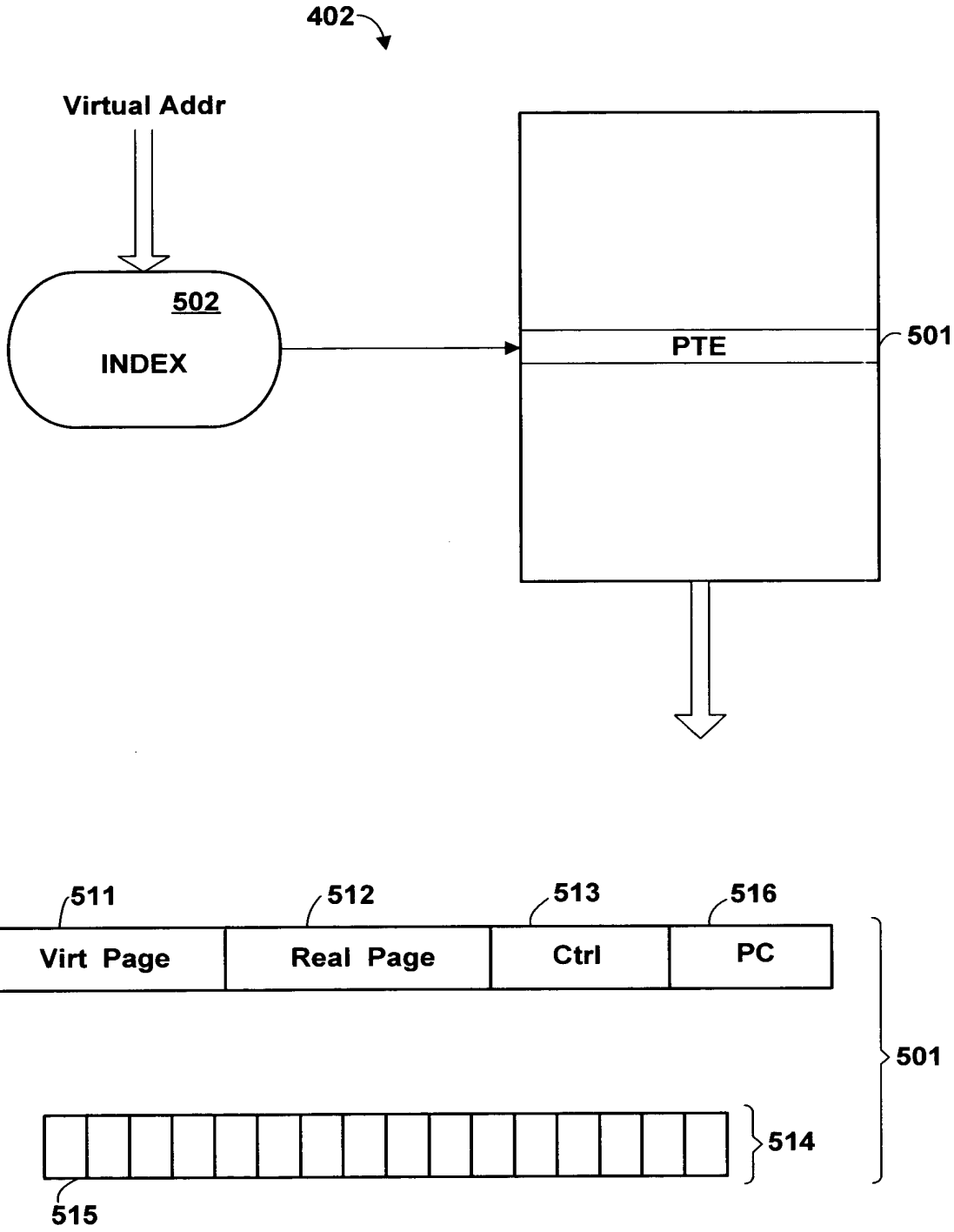

402
Virtual Addr
502
INDEX
PTE
501
511
512
513
516
Virt Page
Real Page
Ctrl
PC
501
514
515

FIG. 5

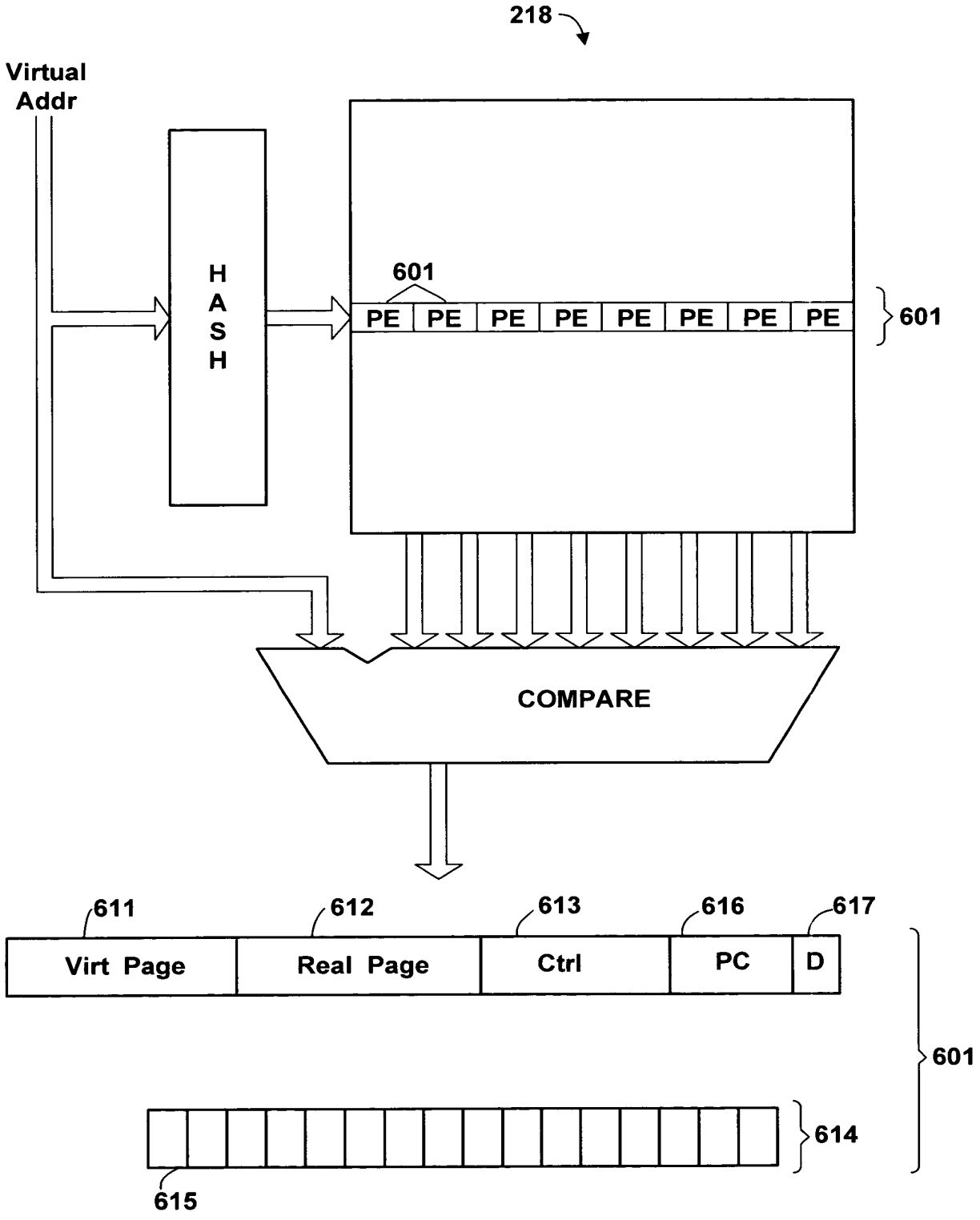

218
Virtual Addr
HASH
601
PE
PE
PE
PE
PE
PE
PE
PE
601
COMPARE
611
612
613
616
617
Virt Page
Real Page
Ctrl
PC
D
601
614
615

FIG. 6

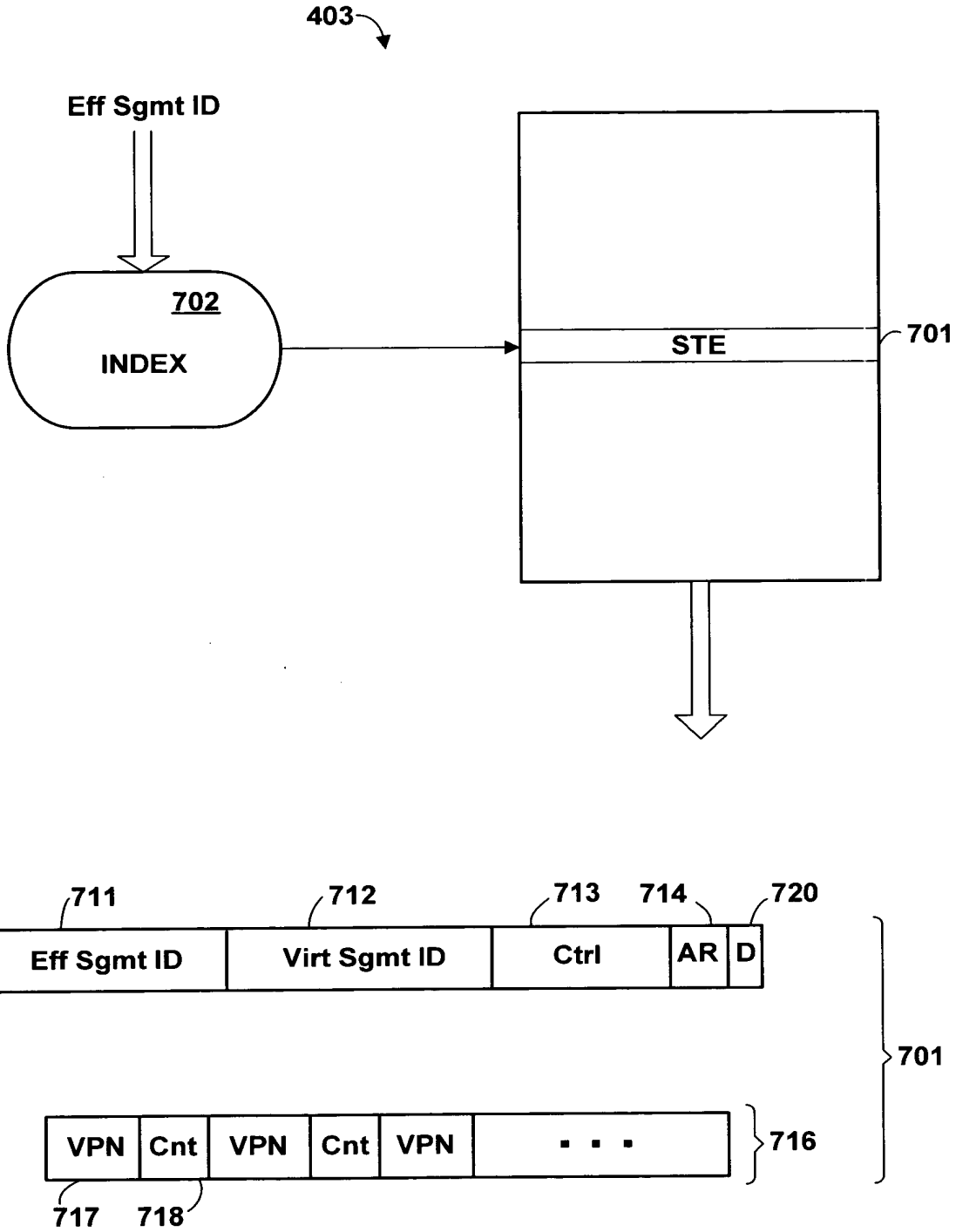

403
Eff Sgmt ID
702
INDEX
STE
701
711
712
713
714
720
Eff Sgmt ID
Virt Sgmt ID
Ctrl
AR
D
701
VPN
Cnt
VPN
Cnt
VPN
716
717
718

FIG. 7

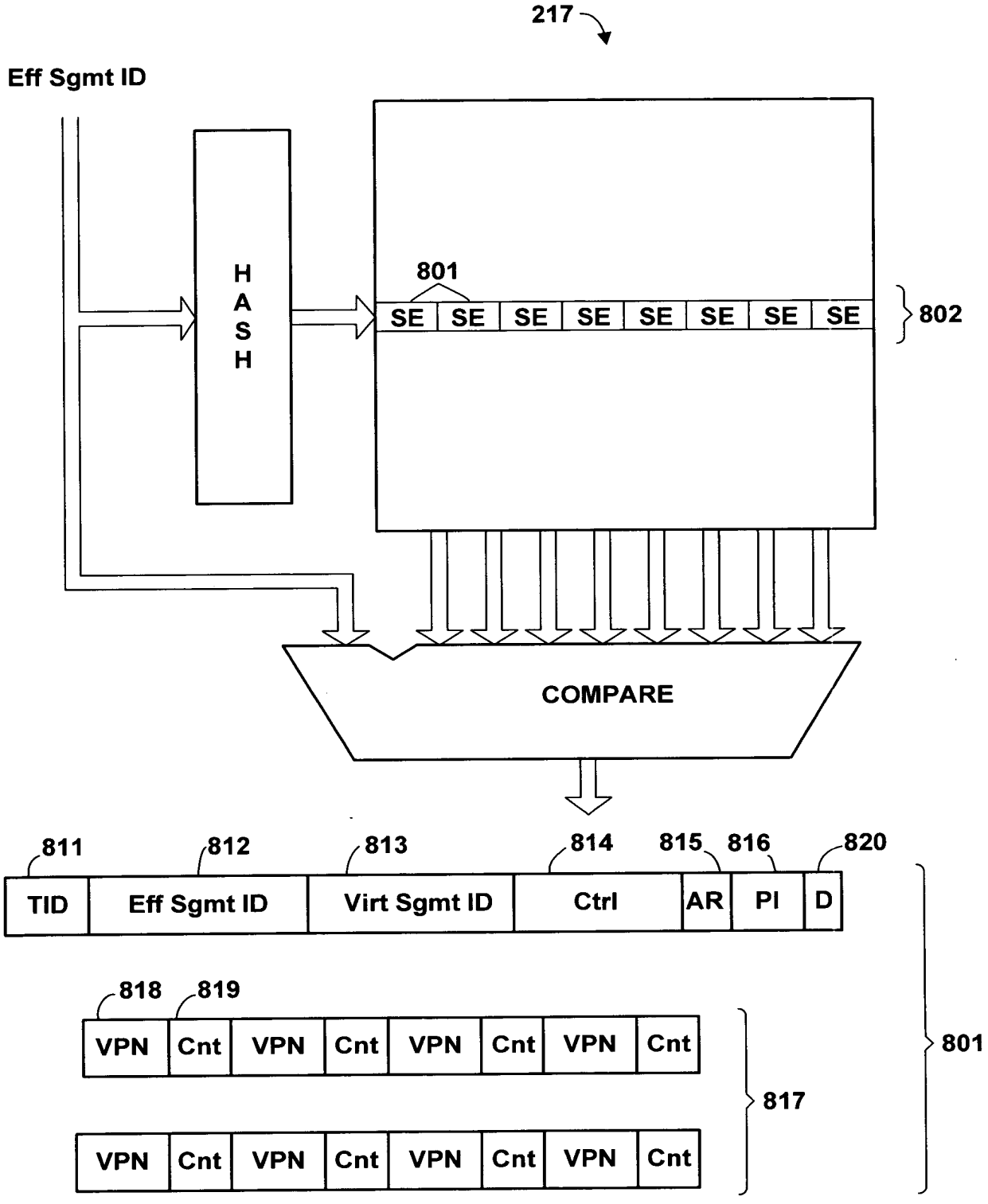
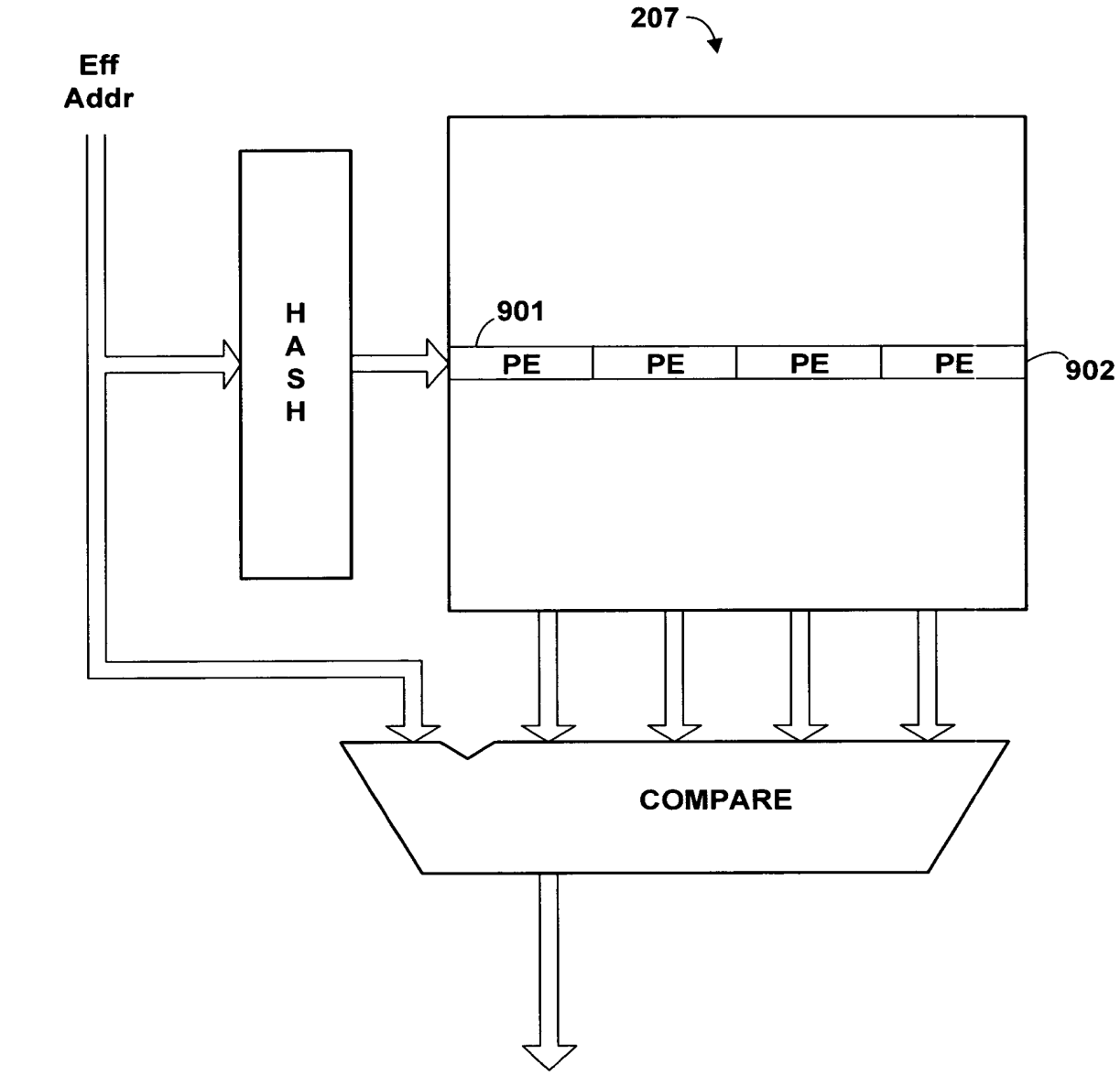

217
Eff Sgmt ID
HASH
801
SE
SE
SE
SE
SE
SE
SE
SE
802
COMPARE
811
812
813
814
815
816
820
TID
Eff Sgmt ID
Virt Sgmt ID
Ctrl
AR
PI
D
818
819
VPN
Cnt
VPN
Cnt
VPN
Cnt
VPN
Cnt
817
VPN
Cnt
VPN
Cnt
VPN
Cnt
VPN
Cnt
801

FIG. 8


207
Eff
Addr
H
A
S
H
901
PE
PE
PE
PE
902
COMPARE

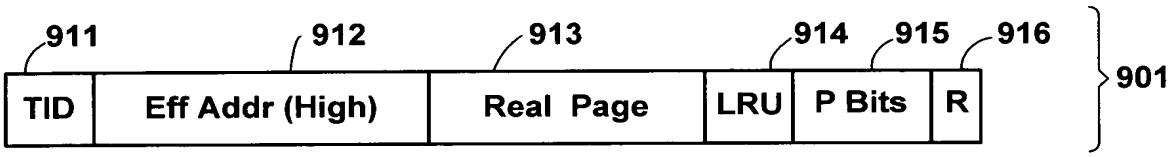

911
912
913
914
915
916
TID
Eff Addr (High)
Real Page
LRU
P Bits
R
901

FIG. 9

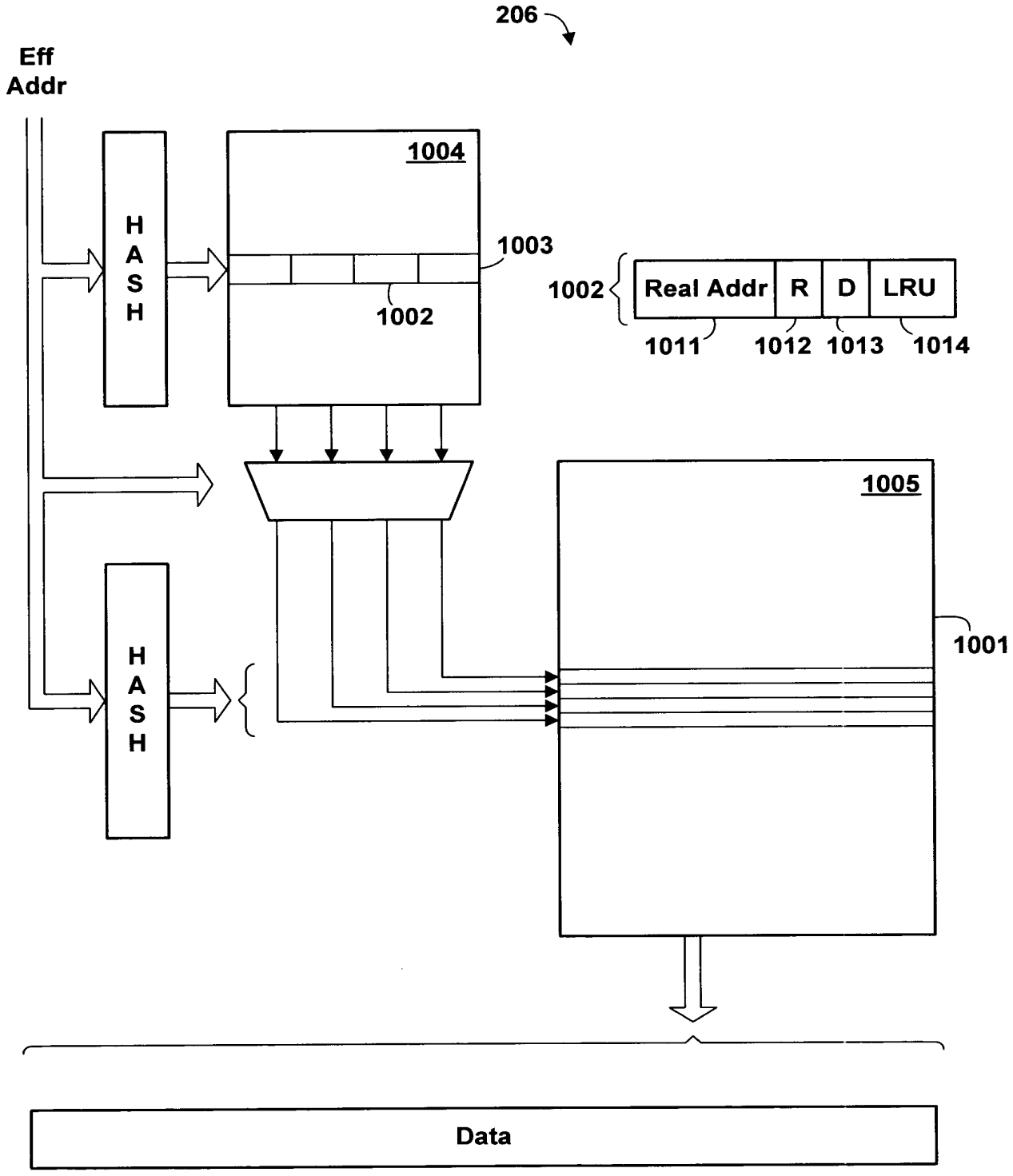

206
Eff Addr
HASH
1004
1003
1002
1002
Real Addr
R
D
LRU
1011
1012
1013
1014
HASH
1005
1001
Data

FIG. 10

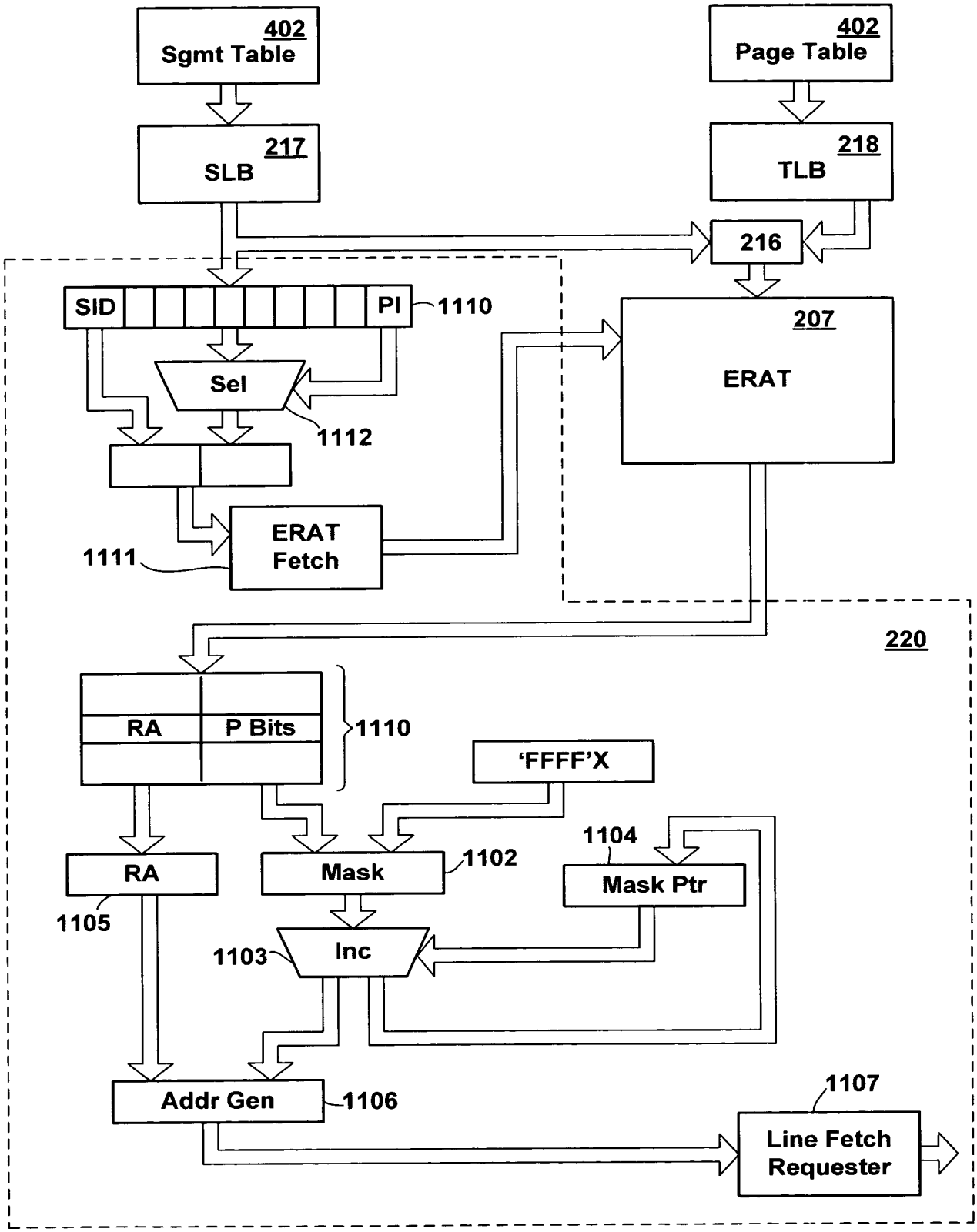

402
Sgmt Table
402
Page Table
217
SLB
218
TLB
216
SID
PI
1110
Sel
1112
207
ERAT
ERAT
Fetch
1111
220
RA
P Bits
1110
'FFFF'X
1104
RA
Mask
1102
Mask Ptr
1105
Inc
1103
Addr Gen
1106
1107
Line Fetch
Requester

FIG. 11

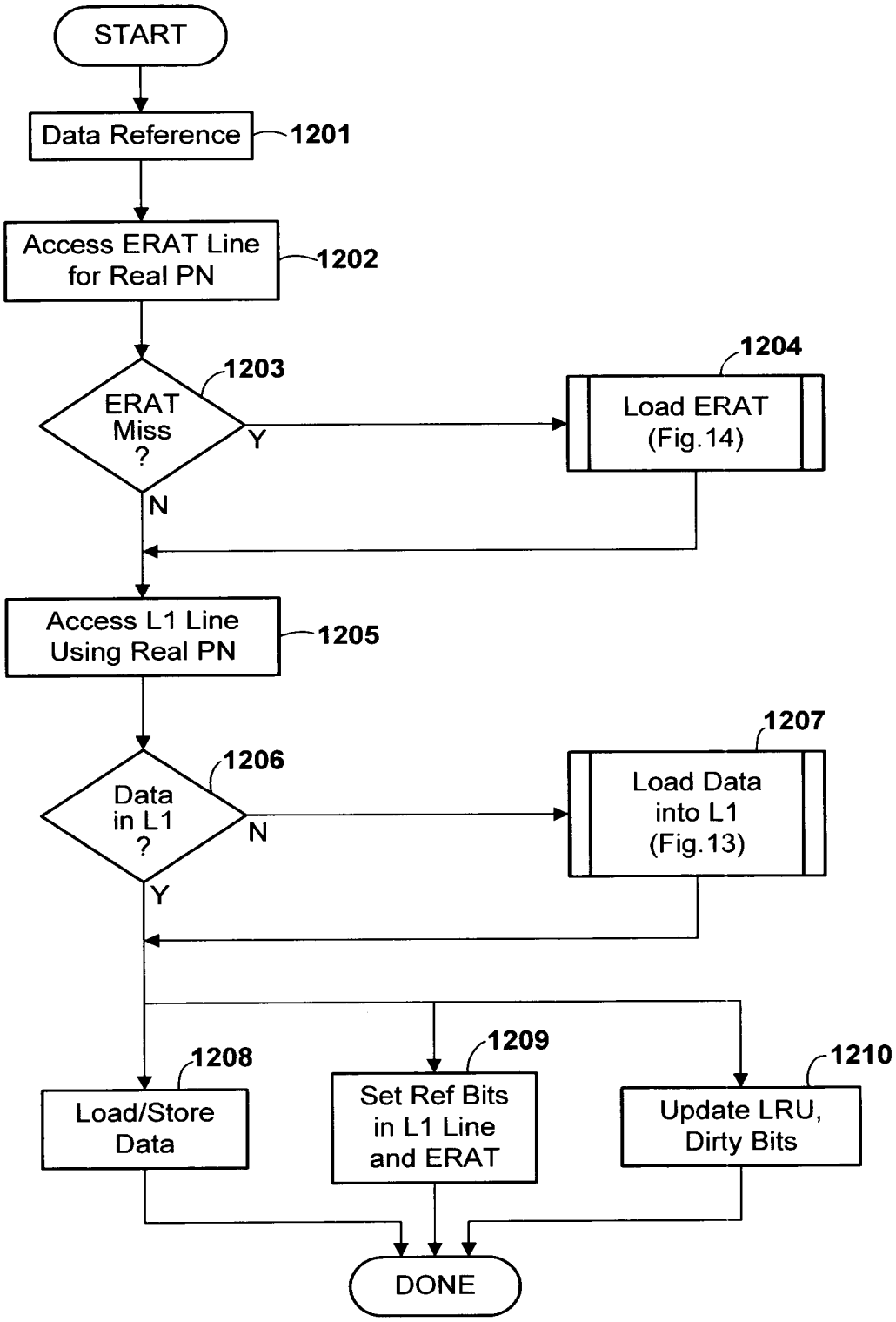

START
Data Reference
1201
Access ERAT Line for Real PN
1202
ERAT Miss ?
1203
Y
N
Load ERAT (Fig.14)
1204
Access L1 Line Using Real PN
1205
Data in L1 ?
1206
N
Y
Load Data into L1 (Fig.13)
1207
Load/Store Data
1208
Set Ref Bits in L1 Line and ERAT
1209
Update LRU, Dirty Bits
1210
DONE

FIG. 12

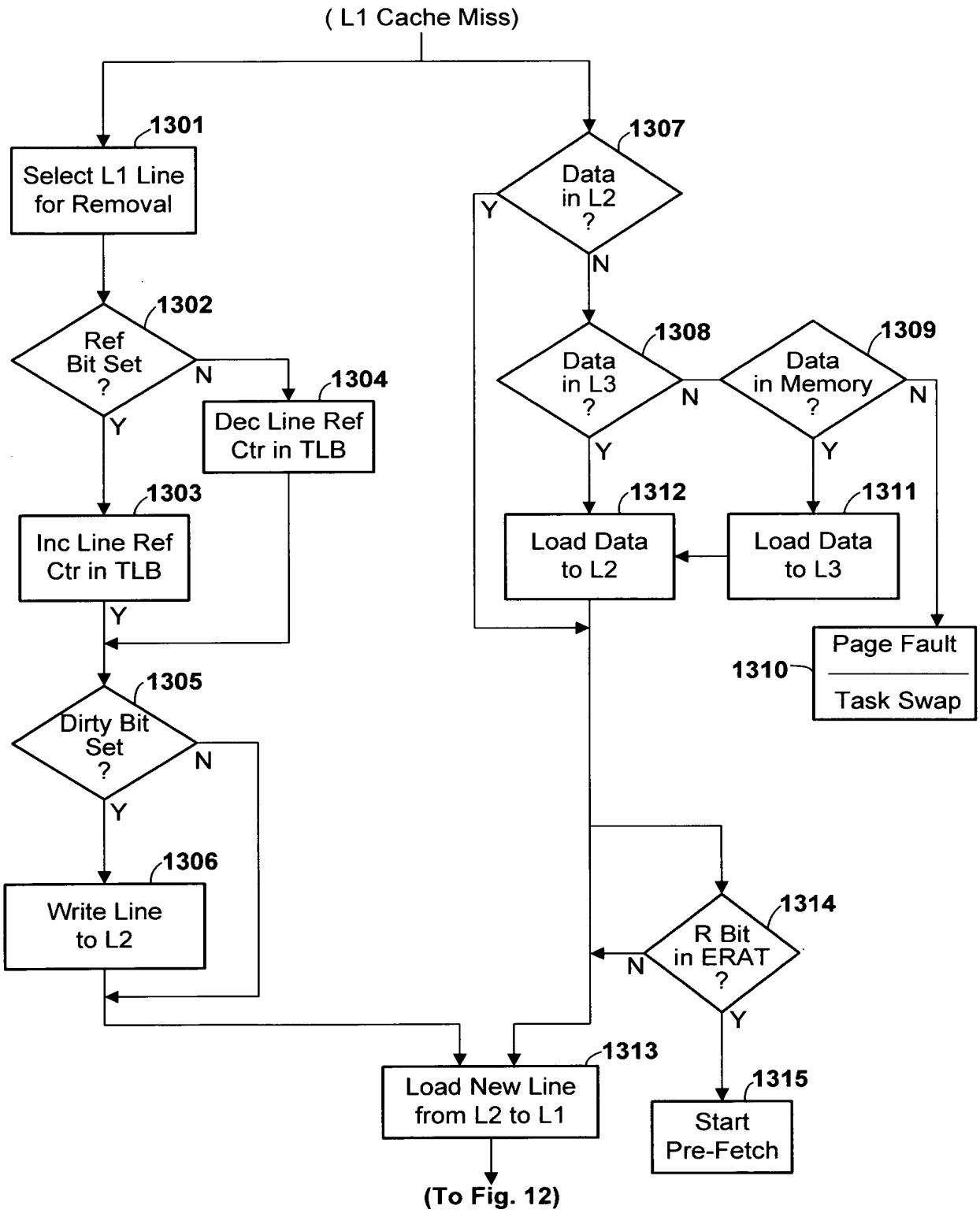

(L1 Cache Miss)
1301
Select L1 Line for Removal
1302
Ref Bit Set ?
N
Y
1304
Dec Line Ref Ctr in TLB
1303
Inc Line Ref Ctr in TLB
Y
1305
Dirty Bit Set ?
N
Y
1306
Write Line to L2
1307
Data in L2 ?
Y
N
1308
Data in L3 ?
N
Y
1309
Data in Memory ?
N
Y
1312
Load Data to L2
1311
Load Data to L3
1310
Page Fault
Task Swap
1314
R Bit in ERAT ?
N
Y
1313
Load New Line from L2 to L1
1315
Start Pre-Fetch
(To Fig. 12)

FIG. 13

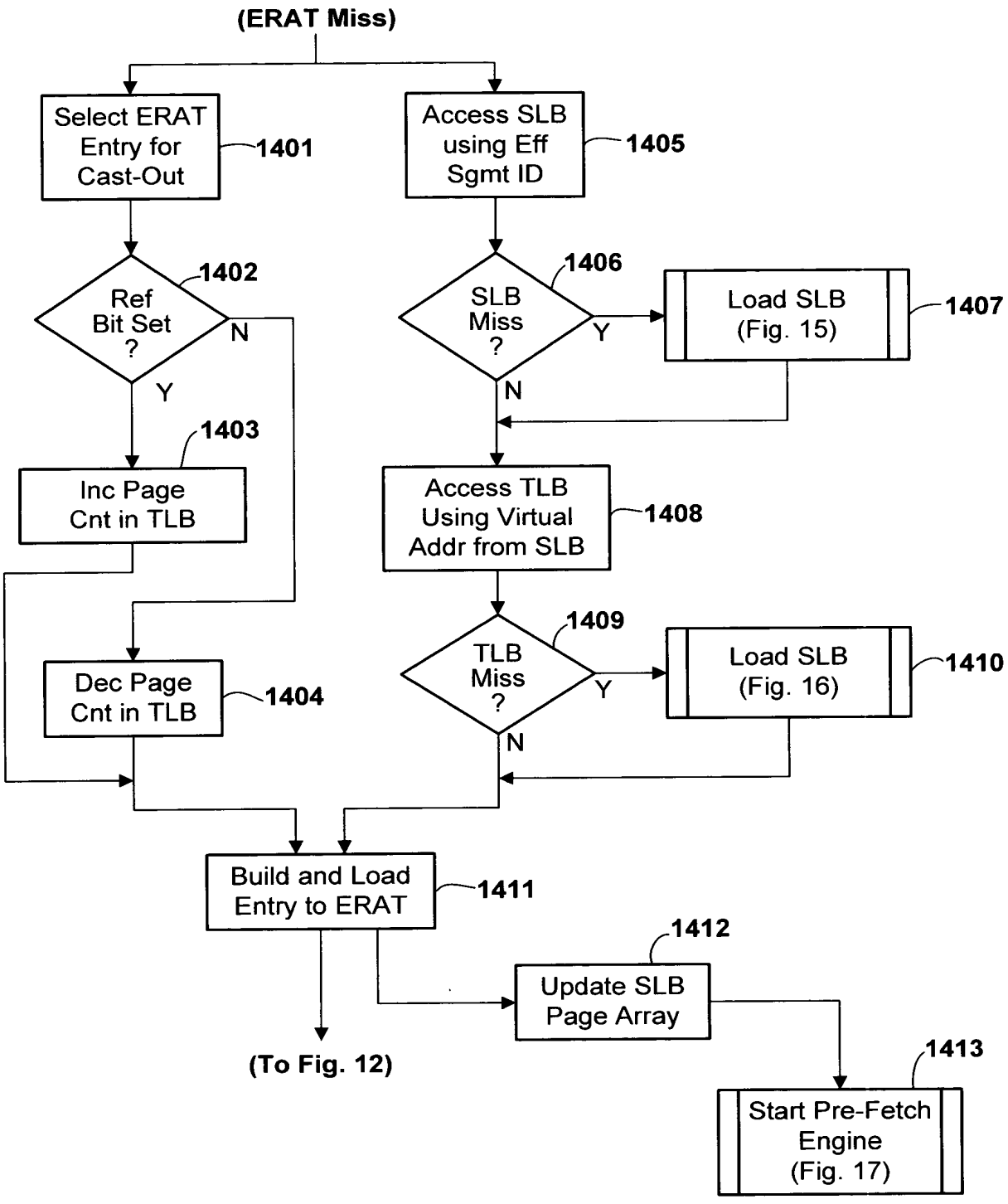

(ERAT Miss)
Select ERAT Entry for Cast-Out
1401
Access SLB using Eff Sgmt ID
1405
Ref Bit Set ?
1402
N
Y
SLB Miss ?
1406
Y
Load SLB (Fig. 15)
1407
N
Inc Page Cnt in TLB
1403
Access TLB Using Virtual Addr from SLB
1408
Dec Page Cnt in TLB
1404
TLB Miss ?
1409
Y
Load SLB (Fig. 16)
1410
N
Build and Load Entry to ERAT
1411
1412
Update SLB Page Array
(To Fig. 12)
1413
Start Pre-Fetch Engine (Fig. 17)

FIG. 14

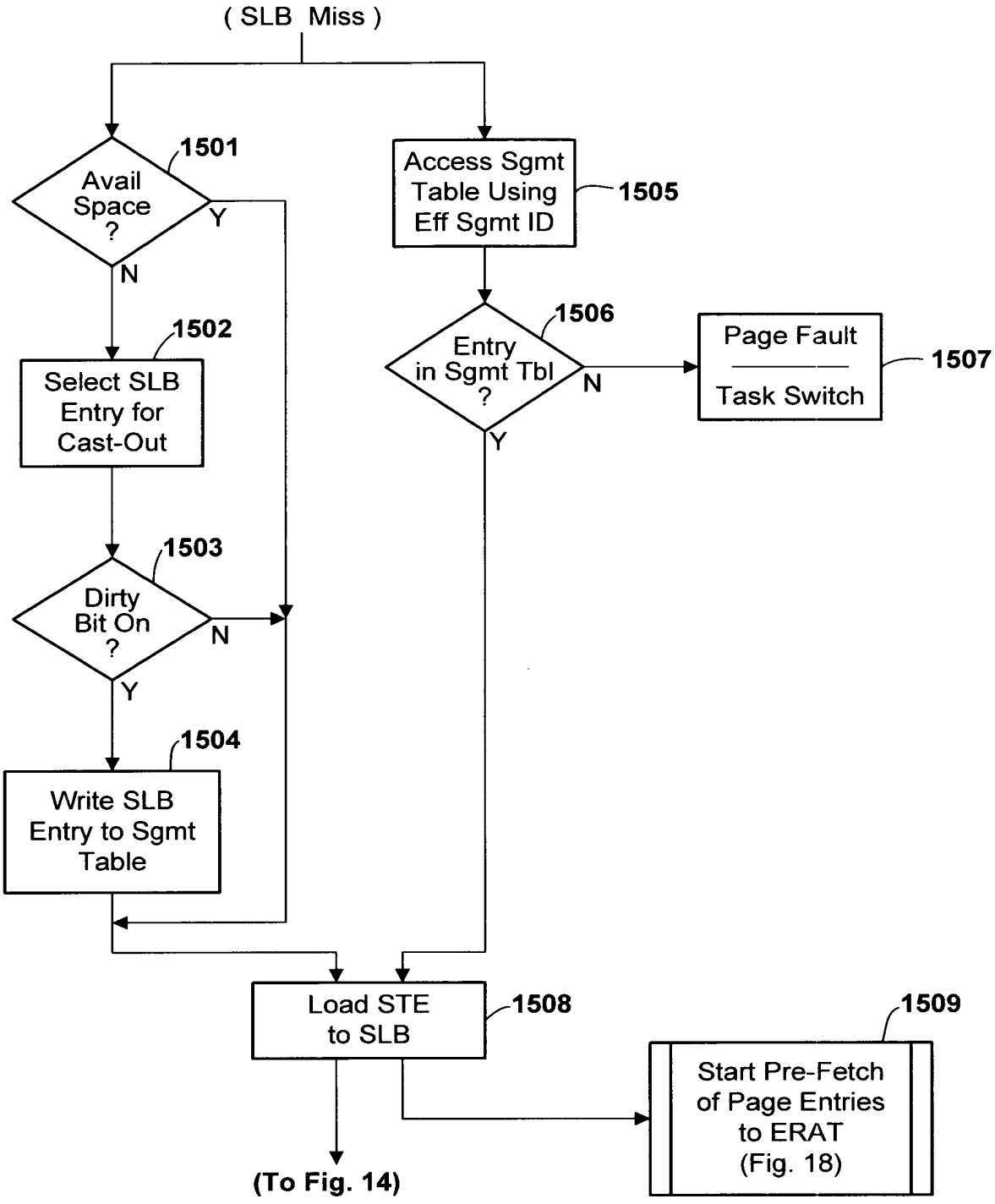

(SLB Miss)
1501
Avail Space ?
Y
N
1502
Select SLB Entry for Cast-Out
1503
Dirty Bit On ?
N
Y
1504
Write SLB Entry to Sgmt Table
Access Sgmt Table Using Eff Sgmt ID
1505
1506
Entry in Sgmt Tbl ?
N
Y
Page Fault
Task Switch
1507
Load STE to SLB
1508
1509
Start Pre-Fetch of Page Entries to ERAT (Fig. 18)
(To Fig. 14)

FIG. 15

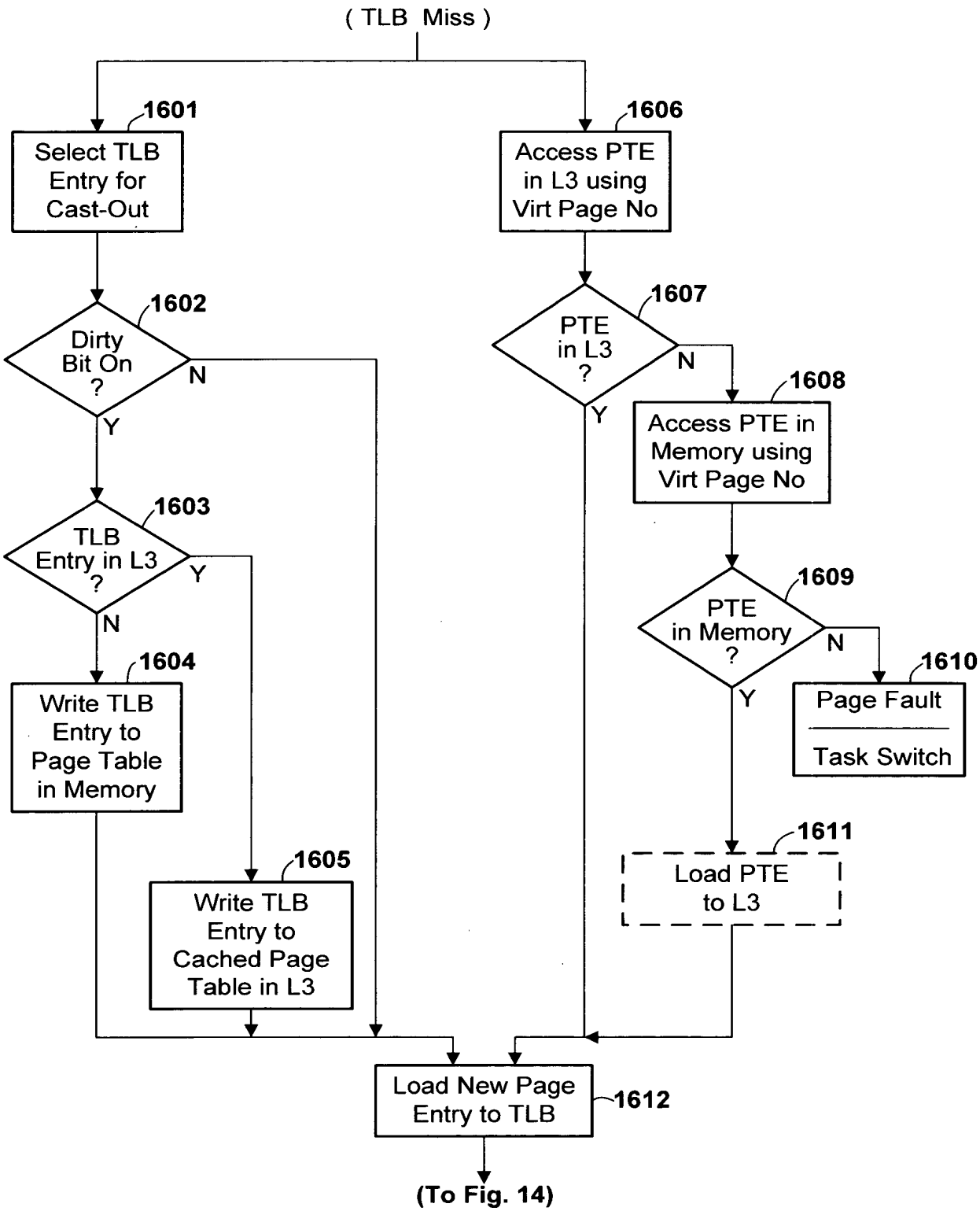

(TLB Miss)
1601
Select TLB Entry for Cast-Out
1602
Dirty Bit On ?
N
Y
1603
TLB Entry in L3 ?
Y
N
1604
Write TLB Entry to Page Table in Memory
1605
Write TLB Entry to Cached Page Table in L3
1606
Access PTE in L3 using Virt Page No
1607
PTE in L3 ?
N
Y
1608
Access PTE in Memory using Virt Page No
1609
PTE in Memory ?
N
Y
1610
Page Fault
Task Switch
1611
Load PTE to L3
Load New Page Entry to TLB
1612
(To Fig. 14)

FIG. 16

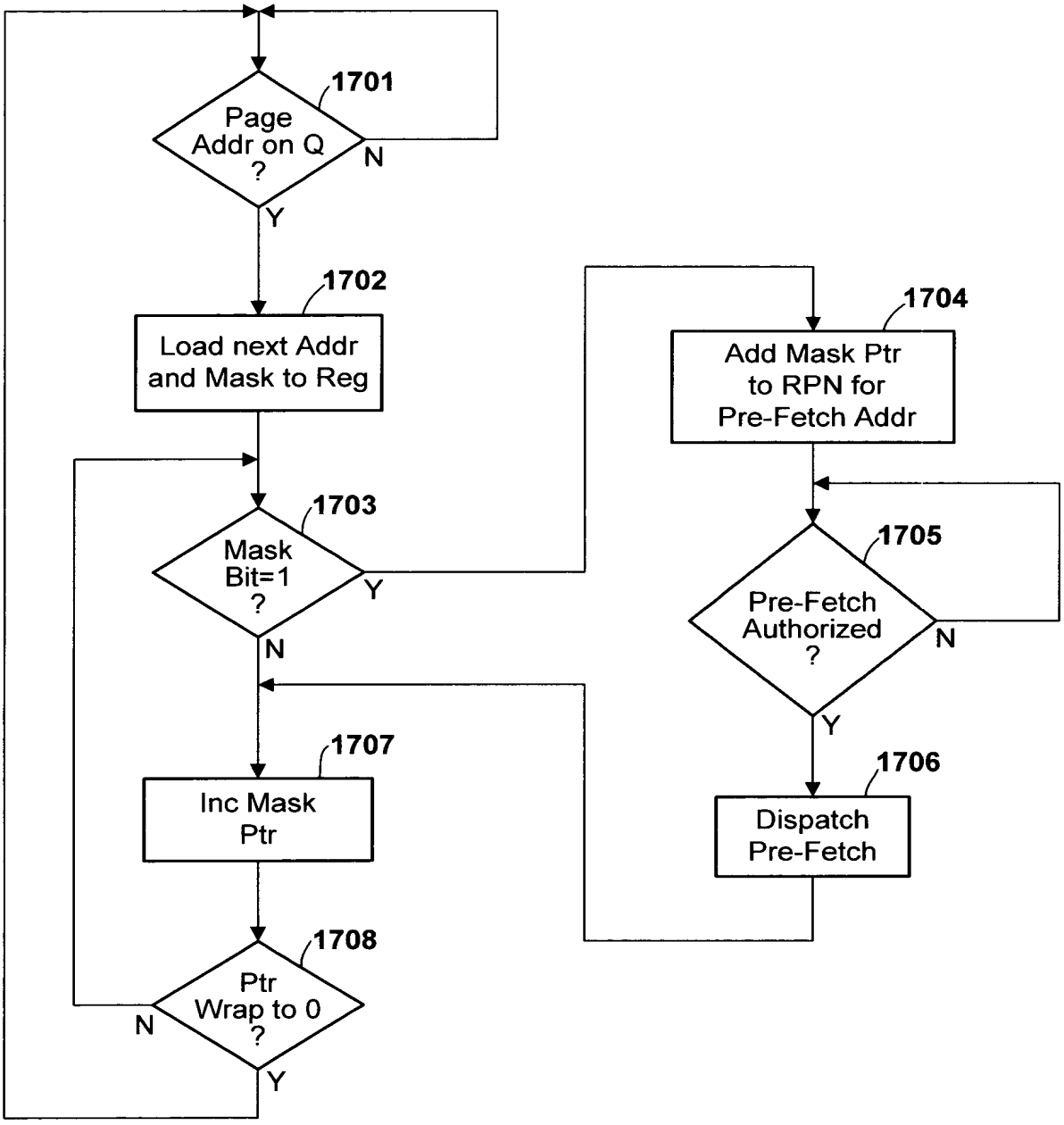

1701
Page Addr on Q ?
N
Y
1702
Load next Addr and Mask to Reg
1703
Mask Bit=1 ?
Y
N
1704
Add Mask Ptr to RPN for Pre-Fetch Addr
1705
Pre-Fetch Authorized ?
N
Y
1706
Dispatch Pre-Fetch
1707
Inc Mask Ptr
1708
Ptr Wrap to 0 ?
N
Y

FIG. 17

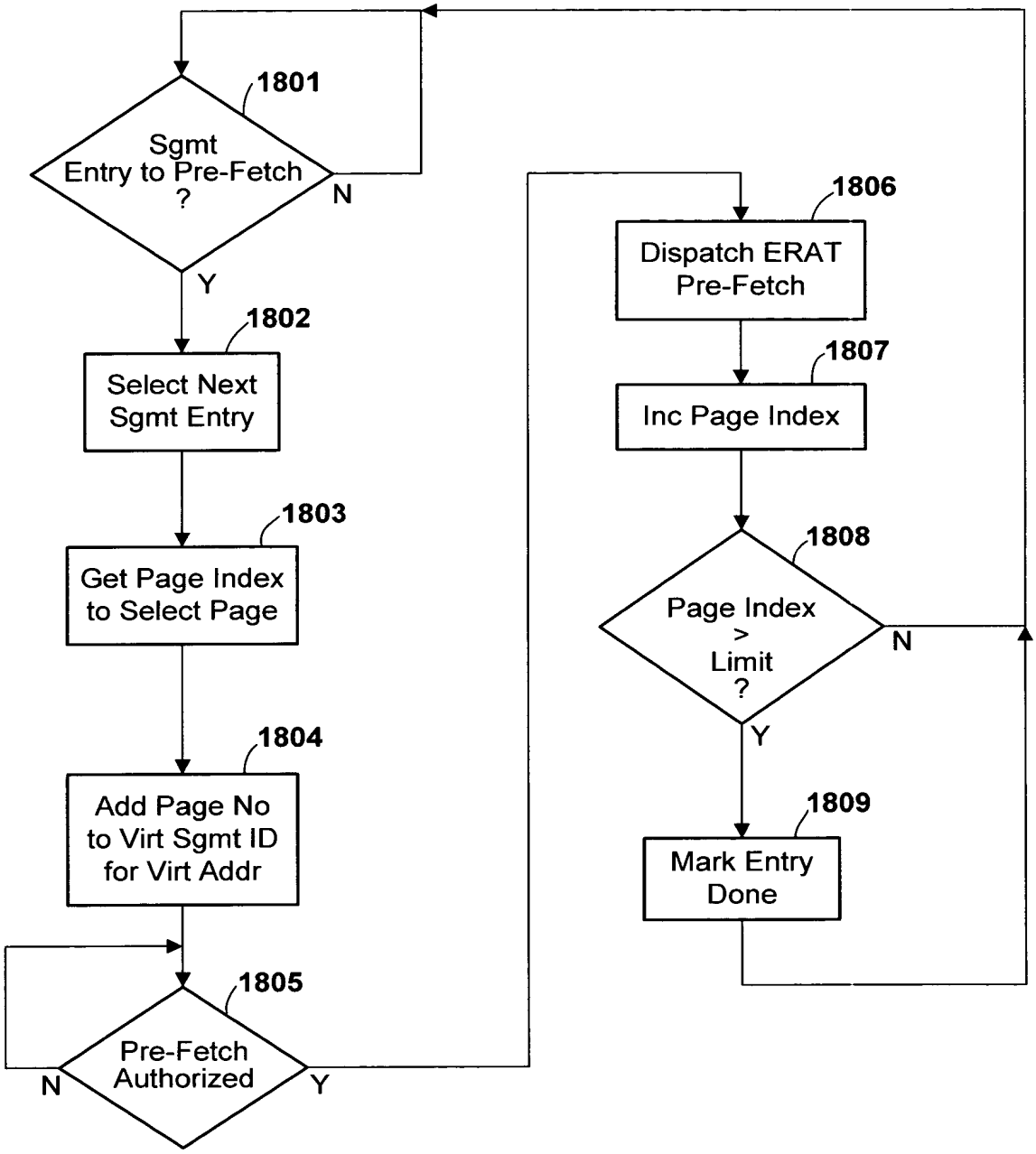

1801
Sgmt Entry to Pre-Fetch ?
N
Y
1802
Select Next Sgmt Entry
1803
Get Page Index to Select Page
1804
Add Page No to Virt Sgmt ID for Virt Addr
1805
Pre-Fetch Authorized
N
Y
1806
Dispatch ERAT Pre-Fetch
1807
Inc Page Index
1808
Page Index > Limit ?
N
Y
1809
Mark Entry Done

FIG. 18